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ESTİMATİON OF GENETİC AND ENVİRONMENTAL PARAMETERS AFFECTİNG PRODUCTİVİTY İN MORKARAMAN SHEEP AND ECONOMİC EVALUATİON OF PARAMETERS

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This study was carried out to protect the continuity of productivity in morkaraman sheep raised in Turkey and determine their economic importance. Morkaraman sheep are concentrated in the Eastern Regions of the country. The province of Bingöl, where the study was conducted, is located in this region and has an important morkaraman population. The study was carried out between 2008-2018. Sixty-eight morkaraman sheep were used during the study period out of 317 lambing lambs. In the study, the total number of lambs born per sheep (TNLBS), the number of weaned lambs (NWL), the weights of the lambs weaned per sheep (WLWS) and the total weight of the lambs weaned in the first period (TWLWFP) were determined. In addition, Additive genetic variance, Error variance, Phenotypic variance, Heritability and Ratio of error variation were determined for these variables.

As a result, the correlation between the examined variables was significant and positive, except for the relationship between TNLBS and TWLWFP. The relationship between these two variables was significant but negative. Significant changes were also observed in terms of genetic parameters. It was concluded that the economic aspects of the examined variables should not be ignored in terms of sustainability.

Keywords: Sheep, morkaraman, sustainability, genotypic and phenotypic variance.

INTRODUCTION

Some animals have a special significance for specific communities and nations. Sheep are also in a different and unique place for Turkish society. For this reason, Turkey is among the few countries in the world in terms of sheep breeding. According to FAO (2018) data, there are 2.3 billion heads of sheep and goats in the world. There are 48 481 000 sheep and goats in Turkey. Of these, 37 276 000 are sheep (TİGEM, 2020). It is pleasing and promising for the future that we have a very high number of animal assets. However, this situation, which is good in terms of numbers, is not the same in terms of efficiency. Regardless of the number, it is necessary to increase efficiency and make healthier production plans for the future. However, it is impossible to make a sound evaluation and plan for the future with low productivity. The priority in sheep breeding is not to switch from extensive to intensive breeding (Kayalık and Bingöl, 2015). For this reason, a significant part of our animals cannot reach their productivity potential because they cannot be adequately fed (Lasseur, 2005).

It cannot be fed adequately under extensive farming conditions and other necessary maintenance is either not done or can be done insufficiently. Of course, this causes a decrease in productivity. Although this is seen as the most suitable method for sheep breeding in our country, it is understood that the method that has been used for many years needs to be changed. Animals will not show performance and productivity if adequate care and feeding are not provided (Kazakopoulos *et al.,* 1996). There are many sheep breeds in our country and they are spread over geographical regions. Due to the deficiencies inbreeding, they are in a very low position in terms of meat, milk and wool productivity. While the Akkaraman breed is the most commonly grown in Turkey, the Morkaraman breed comes second. Morkaraman sheep have a robust and rather large build, a long neck, a narrow chest and a low rump; while the legs are higher, the face and head are without fleece, mixed with fleece and have a fat tail

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(TOB, 2021). Turkey is a very suitable country for sheep breeding. In Turkey, Morkaraman sheep are raised in villages as in other sheep, and care and feeding environments are created according to the possibilities of the breeders. Many products obtained from sheep's meats and milk are preferred much more than animal products (Günaydın, 2009). Increasing productivity in sheep breeding regions is considered an important resource in the industry, depending on the products obtained from this area. In order to increase productivity, first of all, the number of weaned lambs and the weight of the weaned lambs should be increased every year (Duguma *et al.*, 2002). Weaning weights are significant for industrial enterprises working based on sheep meat. Our study determined that 50% of the sheep raised in the region are raised for meat, 40% for milk, and 10% for fleece. Küçük *et al*. (2000) and Schoeman (2000) stated that the thought of wool production in sheep breeding is not as attractive as it used to be, but instead, meat production is prioritized. Yerlikaya and Karagözlü (2008) stated that milk production is predominant in sheep breeding, especially in the Mediterranean Region, and that milk and meat are maintained together in our country.

Determination of phenotypic and genotypic parameters in sheep breeding increases the chance of success in breeding (Esenbuga and Dayıoğlu, 2002). In addition, knowing these parameters in future studies will directly affect the productivity evaluated by growth and development (Arslan *et al.*, 2003). For this reason, it will be important for productivity to be careful at all stages of growth and development, starting with the birth of animals. The total weight of lambs weaned during growth and development stages is the most important measure of flock productivity (Snyman *et al.*, 1997). However, the problem encountered here is the high variation seen phenotypically. As in other sheep, this is also seen in Morkaraman sheep. High variation limits quality production. Bingöl province is a small province located in the Eastern Anatolia Region. The province is structurally very suitable for sheep breeding. More than half of the sheep breeding activities throughout the province are carried out in the north of the province and 5.2% of the morkaraman sheep raised throughout Turkey are raised in this province (BTİM, 2020). Esen (2017) states that Bingöl province is an important region for morkaraman sheep. Karadavut *et al.* (2010), on the other hand, stated that the productivity of Morkaraman sheep is very low in general and the main reason for this is the inadequacy of the knowledge of the business owners. This study tried to estimate the genetic and environmental parameters affecting productivity in Morkaraman sheep and determine the economic values of these parameters. Thus, the fundamental parameters necessary for animals to produce quality products throughout their lives will be estimated.

MATERIALS AND METHODS

Bingöl province is located in the Eastern Anatolia Region of Turkey (Fig.1). Bingöl province is located between 38° 27 and 40° 27 east longitudes and 41° 20 and 39° 54 north latitudes. The surface area of the province is 8,253.5 km². The altitude of the city center above sea level is 1,151 meters. Bingol land is very mountainous. Some mountains exceed 3,000 meters in height. Because of this feature, animal production is done rather than plant production. Geographical conditions have a high impact on the prevalence of small cattle breeding. Morkaraman sheep are the best-adapted animal to the specified conditions. Around 950 000 sheep are bred throughout the province. Sheep breeding is carried out entirely extensively. 95% of the sheep in the province are bred in Karlıova district (BTİM, 2020). The altitude of the district is 1970 meters above sea level. This significantly brings about changes in animal husbandry and reveals different lifestyles in every field. Morkaraman sheep are the animals that have shown the best adaptation to these conditions.

Figure 1. Bingöl province and its location in Turkey.

In the study, records were taken for the number of lambs born between 2008-2018, the number of weaned lambs and weaned lamb weights in the previously determined morkaraman herd. Sixty-eight morkaraman sheep were used during the study period out of 317 lambing lambs. In the study, the total number of lambs born per sheep (TNLBS), the number of weaned lambs (NWL), the weights of the lambs weaned per sheep (WLWS) and the total weight of the lambs weaned in the first period (TWLWFP) were determined. It is known that these characters are important for sustainable production (Duguma *et al.*, 2002). Since some animals are not weaned, they are excluded from the process. Some of the born lambs died a short time later (6.1%).

Three lambing opportunities were given to a sheep and evaluated as such.For this reason, only the data of ewes that had three consecutive lambing opportunities were used in the study. Those who did not have the opportunity to lamb

consecutively were not considered. The age of the sheep used was determined as 2-5 years old. In the study, the total weights of the weaned lambs for each sheep were differentiated by gender and the calculations were made accordingly. The weaning period of the lambs was done at 90 days.

The following model was used in the study;

$$Y=aX + bN + e$$

Where; Y = Observation Vector, a = vector of fixed effects, b = random animal effects vector, X = matrix relating a to Y, N = matrix relating b to Y, e = vector of random residual effects.

While sheep birth type and birth year were included in the TNLBS and NWL values evaluation, sheep birth year was evaluated as a fixed effect for WLWS. In order to determine the effects of fixed effects on the productivity of sheep, their analyzes were made in SPSS 22V program. For TWLWFP, selection and control groups, year of birth and type of birth (single-multiple) of sheep were taken as fixed effects. Components of variance calculated for sheep were estimated by the REML procedure. The model with randomly added animal effects was used for the variance components. The heritability (h^2) was calculated using the study's estimated variance components.

RESULTS AND DISCUSSION

The mean and coefficient of variation values of the characters examined in the study are given in Table 1. When the table was examined, it was seen that the year of birth and selection group were important for all characteristics, while the lamb birth type was found to be insignificant for NWL and TWLFP. While the weight for the weaned lambs per ewe (WLWS) was determined as 73.3 kg, the weight for the total weight of the lambs weaned in the first piece (TWLWFP) was determined as 27.2 kg.

Table 1. Overall averages, coefficients of variation (%) and determination for analyzed characters coefficients.

Variables	Trials			
	TNLBS (n)	Variables	Trials	TWLWFP (kg)
Means	4,9	4,0	73,2	27,2
R^2 (%)	21,3	19,8	26,7	39,6
CV(%)	22,1	29,6	27,3	27,2

*: P<0,05; **: P<0,01; NS: P>0,05

In the study, while the fixed models explained 12.8% of the variance in TNLBS, they explained 18.1% of the variance in NWL. On the other hand, an explanation of variance of 11.6% was realized in the WLWS. On the other hand, it could explain 38.7% of the variance in TWLWFP. The electoral group started to exert significant influence through TWLWFP. Sheeps with multiple births provide 8.1% more lambs for three occasions compared to their single-born counterparts. In addition, this showed itself not only with the number of lambs but also with the weight of the lamb. Lamb weight increased by 18.7 percent. The equivalent of this was determined as 4.6 kg. In the group selected for clean fleece, the sheep had a wool weight of 4.4% compared to the sheep in TWLWFP. The amount of this was determined as 1.7 kg.

The change in the average values of the examined characteristics according to the years is shown in Figure 2. When the figures are examined, it is seen that the number of weaned lambs was a little low at first, but then it increased and stabilized around a certain number (a). The second figure (b) gives the average number of lambs born per ewe per birth. As can be seen, they have very low average numbers. It was determined that the average number of births in Morkaraman sheep was 1.12. The detected number was slightly lower than the general average of morkaraman sheep. In the third figure (c), the average number of births in all three births is given. As it can be understood from here, it is seen that animals give birth to 3.17 lambs on average. In the fourth figure (d), the weaning weights of the lambs are given. It is agreed that the average weaning weight is 40.17 kg. Akcapinar et al. (1982) stated that the average number of births in Morkaraman sheep ranged from 1.28 to 1.30. Askin et al. (1983) stated that the twin birth rate in Morkaraman sheep raised in village conditions was around 5%. In addition, it has been determined that weaning weights are around the Turkey average (Esenbuga and Dayıoğlu, 2002; Yıldız and Denk, 2006). Although the results obtained are somewhat low, the study area is relatively high and the animals that have adapted to this ecology have been evaluated as the main reason for the difference.

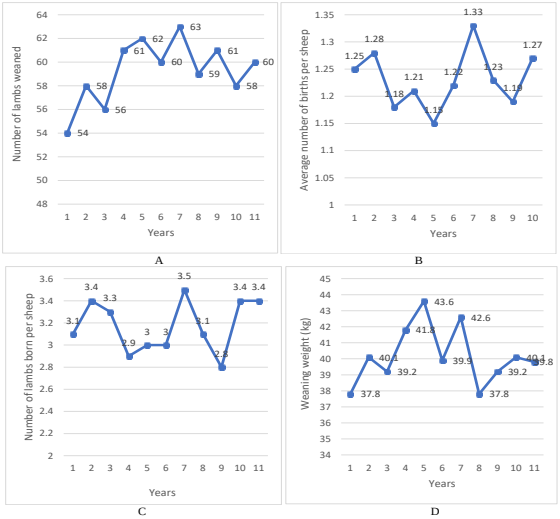

Figure 2. Values of the parameters: a) Number of lambs weaned, b) Weaning weight, c) Number of lambs born from each sheep, d) Weaning weights.

Calculated elements of variance and heritability are given in Table 2. It was observed that additive genetic variance, phenotypic variance and error variance were significantly

higher in the weights of lambs weaned per ewe than in other characters. The main reason for this was the significant differences in the weights of the weaned animals. Although attention was paid to the fact that the feeding and growing conditions were the same, the extensive conditions caused significant changes in the feed utilization levels of the animals. In addition to the difference in utilizing the feed, environmental conditions were affected differently, from weaning to weaning.

Table 2. Variance components and heritability estimates of the studied variables.

Trials	σ^2_a	σ^2_p	σ^2_e	h^2	e^2
TNLBS	0,22	0,97	0,77	0,21	0,79
NWL	0,17	1,12	0,98	0,18	0,88
WLWS	137,16	605,96	516,14	0,17	0,85
TWLWFP	0,35	26,18	25,06	0,02	0,95

σ^2_a; Additive genetic variance, σ^2_e; Error variance, σ^2_p; Phenotypic variance, h^2; Heritability e^2; Ratio of error variation to phenotypic variance

The altitude of the study area is 1970 meters above sea level. There may be sudden temperature and climatic changes, albeit for a short time. It takes time for animals to adapt to these changes. It was accepted as an expected result that the variation in variances was different. It should be considered a result of this change in error variance and height in phenotypic variance. Sheep's heritability for productivity remained moderate. However, the estimated heritability for TWLWFP is very low. e2, which represents the part of the phenotypic variance from environmental factors, was observed the highest in TWLWFP with a value of 0.95, followed by NWL with a value of 0.88. The TNLBS followed the lowest value with 0.79. The increase in this value indicates that the effect of environmental factors increases and the effects of genetic factors decrease. If e2 =1, h2 =0, which means that genetic factors do not affect. This is an extraordinary and exceptional situation and occurs when there is no genotypic difference between individuals (Aksoy, 2003). The heritability of the lactation periods determined in milkable sheep was 0.14. The heritability of lactation milk yield was determined as 0.38. Baro *et al.* (1994) found the heritability as 0.15 in their study in Cura (Churra) sheep, and Taşan (2016) found these traits as 0.15 and 0.40, respectively, in the study conducted in Avesi sheep. Snyman *et al.* (1997) stated that it varies between 0.10 and 0.26. It is observed that the results we obtained are similar to the researchers' results, regardless of where they are, that the sheep are generally reared intensively or tomorrow, and they give similar reactions to environmental conditions.

The genetic correlation results for the variables examined in the study are given in Table 3. Genetic correlations between variables appear to be significant in general. It was determined that there were significant and positive relationships between TNLBS and NWL with a r=0.685** ratio, r=0.612** between NWL and WLWS, and r=0.651** between TWLWFP. However, r=-0.406* significant negative associations were determined between TNLBS and TWLWFP. While the materiality level was 0.05 only for this relationship, it had a significance level of 0.01 for other relationships. Genotypic and phenotypic correlations between the examined characters should be considered, especially if the studies' selection is to be made. Positive or negative aspects of the relationship between these characteristics and the scarcity and abundance may directly affect the success of the studies (Düzgüneş *et al.*, 1992) because there will be significant differences in terms of evaluation between being positive and important and being negative and important (Nicholas, 1988). The fact that all correlations except one were positive and significant in our study indicates the direction of the studies to be conducted. Besides the significance of the correlations, their height is also important (Dong *et al.*, 1989). The study is more successful if the number of samples is sufficient and of high value. However, if the number of samples is small and the correlation high, then there may be confusion about the results (Özcan, 1989).

Table 3. Genetic correlations between examined variables.

	TNLBS	NWL	WLWS	TWLWFP
TNLBS	-	1,00+	0,685**	-0,406*
NWL		-	0,612**	0,651**
WLWS			-	0,797**
TWLWFP				-

+ It could not be calculated because the standard error did not occur.

The average lactation milk yield of Morkaraman sheep under extensive conditions was calculated as 67.18 kg, the average lactation period was 151 days, and the average daily milk yield was 458 g. When these calculated values are taken into account, it is seen that the data is slightly below the Turkey average. The priority in animal breeding enterprises is to increase the number and yield of animals with economic value (Yıldız and Yıldız, 2002). In addition, it is expected that these will be transferred to future generations by getting the best performance in breeding studies. However, it is known that this is difficult and time-consuming (Küçük *et al.*, 2000). Because the identification of the genetic structure in the population increases the chances of success of the studies to be conducted (Torun and Özcan, 1991). Recent developments, especially in genetics, have accelerated and facilitated these processes. Defining the population's genetic structure provides the opportunity to reveal the relations of the population with each other more healthily, determine the pedigrees of the animals, and monitor the changes that will occur in the genotypic frequencies. It is thought that the results we have obtained will have a guiding effect on future studies.

***Economic Evaluation of Variables*:** The economic values of the studied variables are quite high. An increase in live births

per animal is a desirable feature. In this study, the sheep breeding activities in the agricultural enterprises engaged in sheep breeding in the province of Bingöl were monitored and it was investigated what these characteristics contributed to the enterprises economically. In the study conducted with 76 businesses, it was determined that the average family size consisted of 4.6 people. The fact that the amount of land suitable for agriculture is very low throughout the province is valid within the study area and the average size of the farm land is 12.7 decares. Although it has a very low rate, the fact that animal husbandry is carried out in natural pastures leaves the production of fodder plants in the background. More than 50% of the entire province consists of natural pastures. Considering that the ratio of feed expenses in animal nutrition has increased up to 60%, it is considered a great advantage. In Turkey, especially since the 1950s, opening up meadows and pastures to agriculture has accelerated. Meadow-pasture areas, 40 million hectares, decreased rapidly to 12 million hectares. However, considering that this figure includes the maquis area, the actual pasture area is estimated to be between 8-9 million hectares. The pastures have lost their ability to meet the roughage needs of the animals. While 80-90% of the roughage requirement used in feeding animals in developed countries is obtained from meadows and pastures, this rate has decreased to 30% in our country and continues to decline (ZMO, 2018). Of course, the inefficiency of pastures is an important factor in this. Every decrease in the use of meadow and pasture means an increase in the cost of products obtained from animals. The increase in product costs directly reflects on consumers.

While 61.2% of the active capital of the enterprises was land capital, 39.8% was determined as working capital. Due to minimal plant production, only 12.8% of the gross production value in the enterprises is obtained from the plant production value and the rest is obtained from the livestock activities. Almost half of the livestock farms are sheep breeding. Among the variable costs included in these activities, feed costs take first place with 65%. Şahinli stated in his study that the place of feed-in animal nutrition does not fall below 60% (Şahinli, 2011). The rest is labor and other costs.

One factor that reduces productivity and economy in sheep breeding enterprises is that sheep breeding activities are carried out in unsuitable places and conditions. In their study, Connoly (2000) stated that 75% of sheep farms are concentrated in unsuitable areas, while Yıbar and Çetin (2013) stated that the profitability of businesses where animal welfare is not thought and prioritized would continually decrease. Mantaca (1998), on the other hand, stated that unsuitable conditions negatively affect the neurophysiological activities of animals, and as a result, the product quantity and quality are negatively affected. Alçiçek and Yurtman (2009) stated that the major success in sheep breeding is the percentage of lamb per sheep and the amount of sheep that can be offered to the market. Of course, in order to increase these, animal welfare and appropriate conditions must be provided. In order to increase the efficiency and profitability of enterprises by improving their economic characteristics, it will be necessary to increase the yield per animal as a priority. In order to increase productivity per animal, the first thing to do is to improve the genotype and then adapt the environmental conditions to this genotype (Grootwine and Pollott, 2000).

In order to make the specified features more successful, some economic conditions must be fulfilled. Economic problems experienced throughout the region prevent quality production and increase production. Because the producers in the region are not willing enough to develop themselves on the subject, the problems are increasing and their solution is getting more difficult day by day. First of all, even if feed prices cannot be reduced, specific price stability should be ensured and it should not put too much burden on the producer. 36.6% of the producers we interviewed complained about the very high feed prices. 29.3% of them stated that they had severe problems in the marketing of the products produced and that there would be no success in production without overcoming these problems. 11.8% stated that they do not have enough information for modern and efficient sheep breeding. 10.2% of them stated that there are problems with the organization at every stage of sheep production, and 8.4% stated that the state should support them as needed. The remaining 3.7% focused on other reasons. Solving these problems, which manufacturers primarily focus on, will make the features discussed in this study healthier and the results obtained be successful.

***Conclusion*:** This study was carried out on morkaraman sheep in Bingöl province, located in the Eastern Anatolia Region, where morkaraman sheep are intensively bred in Turkey. In the study, the total number of lambs born per ewe, the number of weaned lambs, the weights of the weaned lambs per ewe, and the total weight of the lambs weaned in the first period, which has a significant place in the sustainability of the productivity and productivity of the ewes, were examined. According to the results obtained, it is understood that the producers do not show the necessary and sufficient importance for these variables. The main reason for this was determined as the economic attention of the producers in different directions. It has been observed that the environmental impact is quite high at all stages of production. It is understood that environmental regulations and activations will provide significant benefits in terms of continuity. The high and significant correlation between the variables indicates that it should be evaluated in breeding studies. It is expected that the results obtained will be more realistic in the studies to be evaluated both genetically and economically. Because it will not be enough to focus on genetic facts without focusing on economic requirements, and it will not be sustainable either.

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Conflict of interest: Authors have *conflict of interest.*

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